GENERATING CURRICULA: A HUMAN-CENTRED PERSPECTIVE IN THE ERA OF ARTIFICIAL INTELLIGENCE

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Abstract

This study explores generative mechanisms of curriculum design from a human-centred perspective, with a focus on the integration of Artificial Intelligence (AI) into engineering education. As curricula evolve to meet the demands of a technologically advanced and globally connected society, it is crucial to preserve the educational values rooted in human agency, cultural context, and pedagogical reasoning. The research aimed to investigate how traditional curriculum development processes can be enhanced through AI tools while preserving the essential role of human educators. A mixed-method approach was used, combining quantitative Likert-scale surveys and qualitative open-ended responses from 43 participants involved in curriculum development and implementation across higher and vocational education and industry. The results show that AI is perceived as highly effective in automating administrative tasks and personalizing learning, but concerns remain about ethical issues, data privacy, and potential marginalization of human educators. Most respondents emphasized that AI should serve as a supportive tool rather than a replacement. The findings underscore the importance of hybrid curriculum models that integrate AI for operational efficiency while maintaining human agency in decision-making, pedagogy, and ethical oversight. The study offers practical implications for future curriculum reforms and teacher training in an AI-enhanced educational landscape.

Keywords: *Curriculum Development, Artificial Intelligence in Education, Human-Centred Learning, Engineering Education, Generative Mechanism of Curricula.*

Introduction

Estonian scientist and zoologist Aleksey Turovsky has noted that no child or animal can survive without learning. Learning is a fundamental human intellectual activity, rooted in experience and aimed at acquiring new knowledge and skills, experiences, and behaviour. It may arise spontaneously through everyday encounters or be carefully planned and structured within educational systems. This duality between spontaneous and planned learning forms the background against which any curriculum–the formal plan for learning–evolves.

However, it is essential to recognize that learning is not only an individual process. As Paulo Freire (2018) has highlighted, education is also a social act, influenced by cultural and political contexts. The curriculum serves not only as a tool for individual

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development but also as a mechanism through which societies establish values, norms, culture, and ideologies for future generations.

Higher education, which should train specialists for different areas of life, needs a rationally organized starting point - general education. This is specific to each society, which presumes somewhat different selection of the learning content (in the humanities) and a common part, as STEM (Science, Technology, Engineering, and Mathematics) is global and almost similar everywhere.

The higher the educational level a learner reaches, the greater the role of field-specific knowledge becomes. Also, in the term "know-how" of knowledge-based skills, the word "know" comes first, and specialist knowledge is inevitably international, because of technologies. All skills are based on knowledge. The question is mostly where this knowledge can be applied and whether there are relevant resources or not. Due to the lack of appropriate environments, not all kinds of specialists can be trained in some countries.

Learning takes place across diverse contexts–from homes to higher education institutions–being influenced by the learners' age, environment, and personal capabilities. Historical precedents, such as Goethe's travels to Italy or British educational tours across Europe, exemplify the long-standing tradition of experiential learning.

The importance of context in learning is highlighted by Lev Vygotsky (1978), who emphasized the role of social interaction in cognitive development. The Zone of Proximal Development (ZPD) concept suggests that learners progress when guided by more knowledgeable persons - whether peers, mentors, or teachers. Thus, educational environments should be seen not only as places for individual learning but also as collaborative spaces that encourage sharing of knowledge and experiences.

The present study examined the evolving role of Artificial Intelligence (AI) in the process of curriculum development, alongside the traditional human-driven processes, to better understand how these two forces can be united to enhance educational practice. The aim of this study was to explore the mechanisms of curriculum development in the context of engineering education, with a specific focus on the possibilities of integration of AI and its influences.

Curriculum as a Structured Whole

Curricula are structured documents that usually present educational aims, content, expected outcomes, and assessment methods, providing a roadmap for organizing learning at various stages of education. However, these documents are not static. According to William Pinar (2012), curriculum development remains a "complicated conversation" within the society, where social groups negotiate what is considered worth learning, typically following the cycles of every 10 years.

Curriculum development employs various verbs such as "design," "compile," or "write," each emphasizing different aspects of this process. The outcome is more than a document–it is a social and cultural contract and intellectual artifact. Curriculum, as a product of negotiations, consensus, and agreement, is deeply interwoven with political and social ideologies. It can both reflect and reinforce existing national power structures, as discussed by Michael Apple (2004) in his work on the "hidden curriculum."

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The concept of "hidden curriculum" created by Philip Wesley Jackson (1968) explores how education systems transmit implicit values that shape students' identities, behaviours, and social roles. This hidden curriculum often reflects societal hierarchies and inequalities, such as class, race, and gender, which may not be openly acknowledged, but are nonetheless deeply native within educational practices.

Curricula not only prescribe what must be learned (explicit curricula) but also imply social values and norms (implicit curriculum) and omit certain content (null curriculum). Several scholars have explored these layers, noting that neglecting the hidden curriculum renders teaching and learning insignificant. As Ted Aoki (1986) argued, a tension between the curriculum as planned and the curriculum as it exists—a duality essential to understanding educational experiences.

In Nordic contexts, especially Finland, curriculum development reflects a philosophical commitment to *Bildung*—the holistic development of individuals. According to Tero Autio (2022), curricula of comprehensive schools serve as the intellectual centrepieces of society. Finnish educational culture prioritizes adequacy over excellence, recognizing the societal value of vocational education alongside academic routes. Such a balanced approach has contributed to a more equitable education system.

Moreover, the concept of *Bildung* is rooted in the German educational tradition, which emphasizes personal growth and the development of critical thinking skills. This approach is aligned with John Dewey's (1938) philosophy of education, where learning is seen as a continuous process of adapting to one's environment and engaging in reflective thinking. By valuing both academic and vocational education, Finland has achieved a more inclusive and adaptable system serving the needs of its citizens and workforce (Autio, 2022).

Curricula are expected to be focused, well organized, effectively developed, concise, and appropriate for implementation at schools and universities. Curricula are governing documents for organizing learning at different levels, which must be followed according to the standards set by laws and strategic priorities. They are expected to be clear in style, readable, and free from gender, political or religious bias (Läänemets, 2012).

The social role and ideological purpose of education have been the focus of many scholars. Michael Apple (2004) discusses the curriculum as an ideological mechanism in his work "Ideology and Curriculum", noting that curricula not only promote knowledge acquisition but also advocate for certain societal orders and power structures. According to Apple, while education systems are formal, they can reflect and reinforce certain ideological and political interests.

Curriculum development is an ongoing process that requires regular evaluation of current processes in socio-political tendencies of globalization and technological developments. It is of utmost importance to identify outdated content and address potential gaps in existing curriculum documents to ensure their alignment with evolving needs in a particular field of education. Issues of educational economics must be planned and assessed in advance.

Designing and implementing curricula based on different models requires resources, teacher training, and instructional materials. The success of such implementation depends on the systematic support provided. Educational systems must also be flexible enough to adapt curricula to local contexts and changing societal needs, which may not always

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align with predefined models. Several models have been developed to systematize curriculum design, including:

- Wheeler's Model (1967): a five-stage cyclic model emphasizing integration and evaluation.
- Tyler's Model (1969): focuses on defining objectives, aligning content, and evaluation.
- Taba's Model (1962): advocates for "grassroots" curriculum development by teachers.
- Goodlad's Model (1988): includes values, conventional wisdom, and learner needs.
- Kerr's Model (1972): structures learning around objectives, content, experiences, and evaluation.
- Model by Urve Läänemets (2012) (see Figure 1) includes the following steps: "Why?" - formulation of objectives, set according to the scope of the planned process. "How much?" - study time as a resource for achieving balance between time allocated for study and the amount and complexity of the chosen learning content. "When?" - supports determination sequence of learning activities and rational integration of an interdisciplinary approach, learning content, and learning experiences. "What?"- defines the content of learning recognized and valued in a specific society and culture, to shape opportunities for continuing education. "Where?" - how to create a supportive environment for subject-specific learning or integrated learning activities (e.g., projects, challenges, etc.). "Who?" concerns teachers and students participating in the learning process, preliminary knowledge of the students, and the availability of the learning materials considered. "How?" - choices of learning and teaching methods and learning forms for learning with understanding.
- Psycho-Didactical Model of Engineering Pedagogy, designed by Adolf Melezinek (1999) and developed by Tiia Rüütmann (2023) is an iterative process for design of a curriculum or syllabus, starting from design of learning goals and outcomes and ends with reflection and analysis of students' feedback for the purpose of further improvement and ensuring constructive alignment (see Figure 2).

In engineering education, the integration of Problem-Based Learning (PBL) and Project-Based Learning (PjBL), within the framework of the CDIO (Conceive, Design, Implement, Operate) as a foundation for developing a curriculum aligns both industry needs and academic rigor (Crawley et al, 2014). These methodologies, when balanced with discipline-based learning, foster an environment, where students can acquire both theoretical knowledge and skills for solving real world problems. Discipline-based learning provides systematic knowledge and abstract thinking, while PBL and PjBL provide analytical and critical thinking. According to Crawley (2014), a balance must be created between discipline-based learning, PBL, and PjBL.

To successfully integrate above introduced pedagogical approaches, it is critical to ensure that the curriculum is coherently designed and that there is constructive alignment between learning outcomes, learners' prerequisites, course content, teaching methods, and assessment strategies. In this context, the curriculum should promote the acquisition

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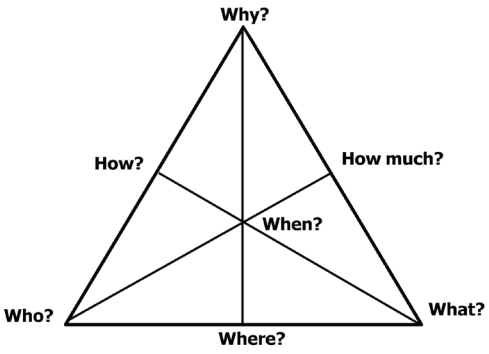
of both theoretical knowledge and practical skills, ensuring that students are prepared for the realities of the professional world. The design of the curriculum must also ensure that learning is progressing using earlier courses, building the foundational knowledge and skills necessary for later, more complex study tasks.

Figure 1

Model for Curriculum Design by Läänemets (2012)



Blatchford and Chen (2020) discuss the integration of AI into curriculum design, exploring the balance between technological innovation and the need for a human-centred approach. AI is becoming a valuable tool for tracking student progress, providing real-time feedback, and creating adaptive learning environments considering learners' needs. Implementation of AI must be carried out cautiously, ensuring that it complements human interaction rather than replaces it.

In the 21st century, technology and AI introduce new dimensions to curriculum development. While offering potential benefits such as adaptive learning systems and predictive analytics, AI also raises concerns about control, bias, and misuse (Kim 2022). Societal readiness, legal frameworks, and ethical considerations must guide AI integration in education. Technology and AI have transformed not only the ways in which learning occurs but also the methods by which curricula are designed and implemented. These technologies raise questions regarding data privacy, security, and algorithmic bias (Kim 2022).

A significant challenge in AI-driven curriculum development lies in addressing potential biases embedded in algorithms. As algorithms are created by humans, they can unintentionally reflect societal biases. This concern was raised by O'Neil (2016) in "Weapons of Math Destruction", where the author argues that biased algorithms can perpetuate existing inequalities in education and other sectors. Thus, while AI offers great potential for personalized learning, it must be implemented within an ethical framework that ensures fairness and inclusivity.

In Estonia, for example, curriculum development has been criticized as ineffective over the past 35 years, hindered by pseudo-democracy and lack of professional leadership. Recognizing such challenges is crucial for initiating meaningful reform. As noted at the World Education Forum in London (2020), curriculum reform should begin as early as kindergarten.

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Figure 2
Psycho-Didactical Model of Engineering Pedagogy

The relationship between learning and education has always been at the core of both theoretical and practical discussions. While traditional curricula have often focused on the transfer of knowledge and theory, in recent decades, emphasis has shifted toward the experiential and critical aspects of learning, as developed by theorists such as John Dewey. Dewey (1938) emphasized that education should not be merely about knowledge transmission, but also a social and reflective process that integrates personal experience with broader awareness, preparing students for adulthood. These ideas had a profound impact on educational theory in the middle of the 20th century, as they helped to shape the humanistic and life-practice orientation of curricula.

Curriculum development, as highlighted by Tero Autio (2022), should not be viewed merely as an organizational structure but also as a means through which society channels the youth and shapes their worldviews, providing carefully selected knowledge for the upcoming generation.

International organizations have played a central role in setting educational standards and promoting a shift from traditional rote learning to competency-based education. The OECD's *Education 2030* framework emphasizes the importance of learning to learn, critical thinking, and collaborative problem-solving as key competencies for future generations. In this context, curriculum development is expected to go beyond content delivery to focus on skills-building, adaptability, and lifelong learning.

Generative Mechanisms for Developing Curricula

The generative mechanism of curriculum and syllabi development includes several elements, which allow for planning relevant, structured activities in this process. Prior data and experience concerning analysis and evaluation, implementation and monitoring, implementing curriculum theories, educational philosophical approaches, and the role of educational policy, as well as curriculum design models and strategies, taking account of

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the nature of learning, have to be studied in-depth**.** It is necessary to consider the current system of education, as well as that designed for future, as a meaningful whole starting from kindergarten and ending up with doctoral studies.

Understandably, educators have started to use generative AI to create personalized and adaptable pathways for student learning. The integrative potential of AI has enabled students to generate their own information, which enhances the retrieval and application of the content learned (Wilson & Bauer, 2024). According to Hand et al. (2021), new national curricula emphasize knowledge generation approaches, focusing on learning practices and generative tools. This has been shown to significantly improve students' content knowledge, critical thinking, and other competencies.

Generative AI can also support teachers' lesson planning by efficiently creating and refining lesson outlines (Powell & Courchesne, 2024). Generative methods are used to develop interactive educational software by promoting explorative learning models. These methods offer high reusability and cost reduction, making them valuable for creating novel learning models.

Advanced models like GPT-3, GPT-4 and Generative Adversarial Networks (GANs) play a central role in generating personalized and adaptable educational content, helping to create virtual laboratories and simulations, enhancing hands-on learning experiences (Wilson & Bauer, 2024; Tariq, 2004). Generative AI has been found to significantly enhance teaching performance by improving ease of use, thereby impacting student-focused learning, learning material development, and teaching practice enhancement (Mulyani et al, 2025). The use of generative learning environments has a positive impact on students' critical thinking skills, science conceptual understanding, language skills, students' learning achievement and learning motivation, including varying impacts on physical, socio-emotional, and intellectual outcomes (Zhu et al, 2025; Liu et al, 2025).

Challenges in implementing generative curriculum design include technical limitations, the necessary teacher training, adaptability, privacy concerns, and ethical issues (Gupta, 2024). Traditional assessment methods in higher education may not operate effectively anymore in the Generative AI era, and there is a need for innovative and refocused teaching and assessment strategies to assess student learning with deep understanding (Gupta, 2024).

Educators and educational researchers should design learning environments that empower students to have ownership in constructing their views of generative AI as future engineers. It can provide professional development, clear guidelines, and access to AI software and technical support to motivate Generative AI integration in education (Xu et al, 2024; Davy et al, 2025).

Effective use of Generative AI in education requires comprehensive teacher training programs, which should focus on developing AI literacy among educators and equipping them with the skills to integrate new tools into their teaching strategies (Yin et al, 2025).

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Research Methodology

General Background

The research methodology employed in this study adopts a mixed-methods approach to explore the integration of Artificial Intelligence (AI) into curriculum development from a human-centred perspective. The study focuses on engineering education and involves 43 participants, including program directors, faculty, vocational teachers, and industry representatives, ensuring a comprehensive multi-stakeholder perspective. The theoretical framework draws on curriculum design models (e.g., Läänemets, 2012; Melezinek, 1999) and emphasizes the importance of human agency, ethical oversight, and hybrid learning models. The research design is purposive, targeting individuals with direct experience in curriculum development, and the scope encompasses higher and vocational education, reflecting contemporary challenges and opportunities in AI-enhanced education.

Sample

This study employed a purposive sampling strategy, targeting individuals with direct experience in curriculum development or implementation in engineering education. The sample comprised a diverse group of stakeholders representing both academic and industry perspectives, including:

- Program directors (curriculum coordinators) from engineering faculties at universities and higher education institutions, responsible for program design and development (n=7).
- Engineering faculty and lecturers engaged in teaching and implementing curricular frameworks into instructional practice (n=11).
- Teachers at vocational schools delivering applied technical education relevant to the engineering domain (n=19).
- Employers or industry representatives contributing to the specification of training needs and offering insights into labour market expectations and technological trends (n=6).

This multi-stakeholder composition of the sample, including 43 participants, ensured a comprehensive understanding of curriculum needs and challenges across educational levels and institutional contexts in engineering education.

Instrument and Procedures

A mixed methods' approach was employed, combining both qualitative and quantitative research techniques to gather comprehensive data on the participants' experiences and perceptions.

Qualitative aspect of the research involved 24 open-ended questions where participants could express their views on the role of human agency and AI in curriculum development.

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The following themes were explored in the qualitative analysis:

- General attitudes towards curriculum development.
- AI in education.
- Human vs. AI influence.
- Skills and competencies for the future.
- Ethical concerns and data privacy

A questionnaire with 6-point Likert-scale response options was used in the quantitative study for identification of key trends in participants' perceptions on generative mechanism of curriculum and role of AI in this process. 21 questions were presented as statements, a response scale used had options from "0 – absolutely do not agree" up to "5 – fully agree". After each statement, it was also possible to leave a comment and explain the answer.

The following quantitative analysis of outcomes focuses on the proportion of respondents who expressed their agreement with the statements by selecting the upper two points on the Likert scale, specifically "agree" and "fully agree", which are interpreted as indicative of positive endorsement of the statements.

Data Analysis

The study employed a dual approach to data analysis, aligning with its mixed-methods design. Quantitative data from the Likert-scale survey (21 items, scored 0–5) were analysed descriptively, focusing on the proportion of respondents who selected the upper two agreement levels ("agree" and "fully agree") to identify trends in perceptions of AI's role in curriculum development. Percentages were calculated to highlight consensus areas, such as AI's effectiveness in personalization (77%) or concerns about data privacy (83%).

Qualitative data from 24 open-ended responses were thematically analysed to explore nuanced perspectives. Responses were coded into five pre-defined themes (e.g., ethical concerns, human-AI balance) using an inductive approach, with representative quotes extracted to illustrate key findings. Triangulation of quantitative and qualitative results enriched interpretations, revealing tensions between AI's efficiency and the irreplaceable role of human educators.

Research Results

This study aimed to identify how AI could contribute to more effective and personalized learning while highlighting the essential human aspects of curriculum development.

Results of quantitative research presented respondents' positive attitudes related to AI including its ability to offer personalized feedback (77% of respondents agreed and fully agreed), track student progress in real-time (37%), offer the support of a virtual assistant (78%), and provide efficient content delivery (e.g. in form of a chatbot 61%).

Negative concerns focused on the perceived risks of dehumanizing education, such as a decrease in face-to-face interaction and collaboration (79%), concerns about data privacy (83%), and the potential for AI to reinforce existing biases (48%).

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Participants emphasized the need for human educators to maintain a central role in guiding students' ethical, social, and emotional development, suggesting that AI should complement human instruction rather than replace it (91%). This highlights the ongoing concern that AI should reinforce the importance of human involvement in education.

Participants were asked to rate the effectiveness of AI in various aspects of curriculum development. Most respondents (77%) agreed that AI is effective for enhancing personalized learning. This indicates strong support for AI's potential when offering tailored educational paths for students. Respondents viewed AI as very effective in automating administrative tasks such as lesson planning (68%), grading and scheduling (72%). This suggests that educators and instructional designers see significant potential in AI to reduce their administrative burden, allowing them to focus on more interactive aspects of teaching. Approximately 74% of participants rated AI as an effective tool in helping to improve curriculum design by suggesting suitable content, which aligns with the idea that AI can assist in organizing and structuring learning material, potentially saving educators time and effort in the planning process. Respondents also pointed out that AI could assist in analysing professional standards (61%), and educational and social demand for relevant education and speciality (53%) in the process of curriculum design.

Most widely used AI tools in curriculum development according to the respondents' experience were: ChatGPT4 (85%), MS Copilot (65%), Claude (56%), Notion AI (35%), Google Notebook LM (32%), DeepSeek (24%).

Participants were asked to rate criteria that could describe the ideal generative mechanism in curricula design where human-centred and AI-supported perspectives are balanced. The following characteristics were pointed out (see Figure 3). As can be seen, the highest value had professional standards and other official regulations (97%). Three criteria (learning content, learning goals, and outcomes meeting educational and social demands) were rated by 85% of respondents, and 84% pointed out the importance of balancing PBL and subject-based learning. 80% of respondents valued the importance of selection of relevant teaching methodology, and 79%, the importance of assessment methodology in the AI era. 71% of respondents valued pedagogical basis and theories as the foundation for curriculum design. Learners' initial level/prerequisites, a safe and supportive learning environment, and admission requirements were valued by 68% of respondents. The lowest rating had the following criteria: constructive alignment (59%), faculty recruitment (52%), structure and modulation (57%), and new technology in the classroom (55%).

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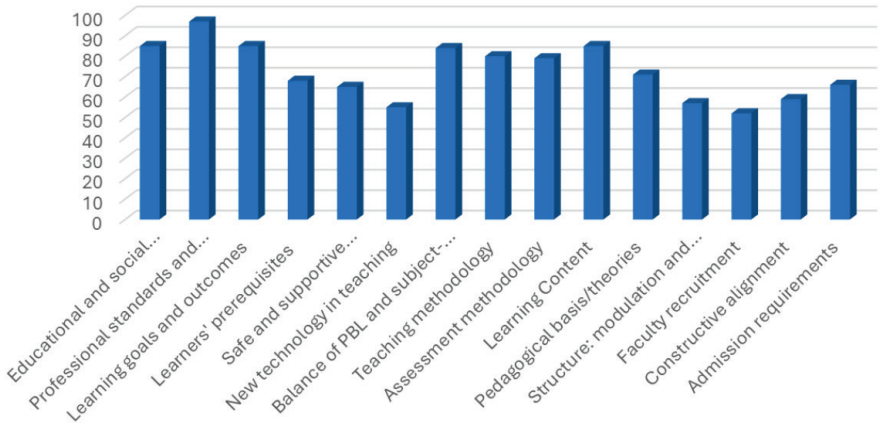
Figure 3

Criteria of Human-Centred and AI-Supported Generative Mechanism for Curricula



The qualitative data was collected from 24 open-ended questions in the survey, where participants expressed their thoughts on AI's role in curriculum development, the challenges it presents, and its benefits. The responses were categorized into the following key themes:

- General attitudes towards curriculum development: questions assessed how participants perceive the importance of curriculum design, the factors influencing its development, and the role of educational institutions in shaping curricula. A participant wrote: *"Curriculum design is not just a technical task; it reflects the broader values and goals of an education system. I believe that without a clear philosophical foundation and collaboration among stakeholders, curriculum reforms risk being superficial or short-lived."*
- AI in education: questions explored the extent to which participants believed AI could support curriculum development, including automation of certain aspects and activities, enhancement of personalized learning experiences, and integration of technology in the learning process. A participant answered*: "AI has the potential to significantly streamline certain curriculum-related tasks, such as aligning learning outcomes with assessments or identifying content gaps. However, its effectiveness depends on how well it is integrated into existing pedagogical frameworks."*
- Human vs. AI influence: a key part of the questionnaire focused on balancing the human and technological influences in curriculum development, probing whether participants felt that AI could replace human agency, or if it should complement the educational process. A participant noted: *"While AI tools can support educators by handling repetitive tasks or data analysis, the human element remains indispensable. Curriculum development involves informed human judgment, cultural sensitivity, and pedagogical intuition—qualities that AI cannot replicate."*
- Skills and competencies for the future: questions explored the competencies that participants believed should be emphasized in the curriculum, including

soft skills (e.g., critical thinking, collaboration) and technical skills (e.g., programming, data science). A participant responded: *"We talk a lot about digital skills, but soft skills are often underestimated. In a rapidly changing world, critical thinking and collaboration are not just 'nice to have'—they are essential for navigating complexity and ambiguity in the framework of speciality studies. But professional competencies remain more important than ever, of course."*

- Ethical concerns and data privacy: A recurring concern among respondents was the ethical implications of AI, particularly around issues such as data privacy, surveillance, and the potential for bias in AI algorithms. One respondent stated: *"One of my main concerns with integrating AI into education is the lack of transparency around how data is collected, stored, and used. Without safeguards and ethical norms, there's a real risk of violating students' and faculty's privacy and undermining trust in educational institutions."*

These findings help to guide future curriculum development policies and practices, especially in engineering education, where the integration of AI tools in teaching and learning environments is becoming increasingly important. Moreover, this research contributes to the ongoing discourse on the balance between human agency and technological advancement in educational systems.

Discussion

Integration of AI into curriculum development brings both potential benefits and challenges. The quantitative analysis suggests that while there is general optimism about AI's capacity to personalize learning, respondents express reservations about its role in replacing human involvement in education. The qualitative analysis provides deeper insights into these reservations, with participants voicing concerns about the loss of human touch in learning experiences and the ethical implications of AI decision-making.

A central theme that emerged, considering both the quantitative and qualitative data, is the concern about AI replacing human educators. While AI can enhance efficiency, participants emphasized that human teachers are crucial for fostering critical thinking, creativity, and emotional intelligence. Despite the efficiency AI offers in terms of data handling and content delivery, the need for human interaction and guidance was repeatedly emphasized. This finding adds a new dimension to the ongoing debate on the role of AI in education, reinforcing that AI should serve as a complementary tool, not a replacement for teachers. One respondent wrote*: "There is a risk that increasing AI involvement might marginalize educators' professional expertise, but also cultural dimensions of education. I believe AI should serve as an assistant rather than a substitute, preserving the educator's role as a critical decision-maker in curriculum design."* The findings suggest that while AI holds a significant potential to enhance various aspects of curriculum development, there remains a strong emphasis on preserving the role of human educators in the process.

Ethical considerations surrounding AI's use in education were also commonly raised by respondents. Universities must establish ethical guidelines for the integration of AI in education, focusing on transparency, fairness, and data privacy to ensure that AI

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systems are used with responsibility. Educators should receive continuous professional guidance on how to effectively incorporate AI into their teaching practices, ensuring that they can leverage the technology, while maintaining control over the learning environment. One consideration of a respondent*: "It is essential that educational institutions take a proactive role in developing ethical frameworks for AI use. Without clear guidelines on transparency, responsibility, fairness, and data protection, we risk deploying technologies that may unintentionally harm learners."*

The quantitative data shows overwhelming agreement on the effectiveness of AI in personalizing learning experiences. This aligns with the qualitative responses, where participants highlighted AI's ability to cater to diverse learning needs. However, a balanced approach is essential, ensuring that AI-driven personalization does not undermine the importance of human judgment and emotional support. A respondent said: *"AI can tailor the curriculum to the individual needs of students, adapting to their pace and learning style. This could greatly benefit diverse student populations with varying levels of competence and readiness. But students also need to learn how to use wisely the new technology, including AI"*

Both the quantitative and qualitative findings emphasize the role of AI in automating administrative tasks. This support suggests that educators appreciate AI's capacity to reduce workload, thus allowing them to focus on more meaningful interactions with students. However, concerns about technology dependency and its integration into educational practices remain. One responder stressed: *"The curriculum may be created by an interdisciplinary team, where AI helps to process information and find the focus, but the final decisions must be made by a human".*

This study also contributed new insights into the potential for hybrid models of education that combine the strengths of both AI and human educators. Participants emphasized the importance of finding a balance between technological tools and human involvement in creating a well-rounded learning experience. It also aligns with the growing interest in hybrid models where AI can be used for tasks such as personalized content delivery, while educators focus on fostering social-emotional development, critical thinking, and providing support tailored to students' needs. This hybrid approach offers a practical model for the future of education, wherein AI serves to enhance, not overshadow, the human element. One respondent wrote: *"I see real value in a hybrid educational model where AI handles data-driven personalization and administrative tasks, allowing educators to concentrate on what machines cannot do—mentoring, motivating, and responding to students' emotional and cognitive needs in real time."*

Development of curricula should follow a systematic, iterative, cyclic process that involves defining educational objectives, identifying the necessary content, selecting appropriate teaching methods, and continuously refining the curriculum based on feedback from various stakeholders.

Generative mechanisms of curricula design are presented in Figure 4, designed according to the respondents' viewpoints in the present study. According to Figure 4, curriculum design depends on the input from international developments, resources, strategic needs, and short-term needs to design relevant aims, content, environment, and achieve recognition.

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Figure 4
Generative Mechanism of Curriculum Development Designed Based on the Present Study

Integration of AI into curriculum development is a transformative process that requires careful planning, ethical consideration, and collaboration. Findings from this study provide a foundation for future research and practical applications, emphasizing the need for a balanced approach that preserves the human element of education while harnessing the capabilities of AI. By following the outlined future steps, educational institutions can ensure that AI enhances, rather than replaces, the rich and multifaceted process of teaching and learning.

Conclusions and Implications

Curriculum development remains a dynamic and multifaceted process, deeply rooted in societal values, educational philosophy, and evolving technological contexts. This study underscores the critical importance of maintaining a human-centred approach in curriculum design, even if AI becomes increasingly integrated into educational systems. While AI offers promising tools for personalization, efficiency, and innovation, it must remain a complement–not a replacement–for human educators, whose emotional intelligence, ethical reasoning, and pedagogical judgment are irreplaceable.

The research findings affirm that effective curriculum design requires a careful balance between tradition and innovation, global trends and local relevance, as well as automation and human agency. The proposed generative mechanism emphasizes a structured, iterative, and inclusive process that responds to learners' needs, industry demands, and societal change.

Ultimately, education must remain a human endeavour, empowered—but not dictated–by technology. As we move forward, meaningful collaboration between educators, technologists, and policymakers will be essential to ensure that curricula continue to inspire, empower, and prepare learners for our uncertain and rapidly changing world.

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As integration of AI into curriculum development continues to evolve, there are several key areas for future exploration and implementation. Considering the positive feedback regarding AI's potential to personalize learning, one key next step would be to develop and refine AI-supported curriculum models that allow educators to integrate technology seamlessly into their teaching practices.

In the future, the establishment of clear ethical guidelines for the development and deployment of AI in educational contexts will be crucial.

Given the increasing role of AI in education, it is essential that educators receive ongoing professional guidance and training, considering AI tools and their pedagogical applications. This will equip teachers with the necessary skills to use AI effectively, understanding both its potential and limitations. Additionally, fostering a critical understanding of AI's impact on pedagogy and learning will empower educators to make informed decisions about when and how to use AI in their classrooms.

One promising direction is the exploration of hybrid models of education that combine both human and AI-driven instruction. Such curriculum models could ensure that AI can handle repetitive tasks and data analysis, while educators continue to provide the human interaction, critical thinking opportunities, and emotional support that students need.

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